Spatial distribution of bound excitons in CVD grown mono- and bilayers MoS_2 in low-temperature regime

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In this work we investigated how sulphur concentration affects the electronic structure of CVD grown MoS_2 samples. Understanding defect influence on optical and transport properties of MoS_2 samples is of great importance since this material has promising application in optics and optoelectronics [1]. In order to have a systematic approach, we investigated samples grown under different synthesis parameters, namely, growth temperature T_G, sulphur temperature T_S and argon flow Φ. Using two complementary techniques, micro-photoluminescence (PL) optical mapping and AFM, at certain synthesis parameters, discrepancies between edges and central parts of MoS_2 flakes were observed, as shown in Figure 1. Possible explanation for this behaviour is the increased defect concentration, primarily sulphur vacancies [2], [3], [4] at the sample edges. Line profile (Fig.1.b)) of the KPFM measurement shown in Figure 1.a) implies that the edges of the MoS_2 flake are negatively charged with respect to the middle part, which suggests the change in the electronic structure. We investigated sulphur vacancies and their influence on optical spectra in the low-temperature limit using PL micro-spectroscopy. Low-temperature optical spectra reveal additional feature corresponding to the bound excitons. Spectral contribution of such bound excitons in overall optical response of the crystal provides us with quantitative information on defect states, as well as their spatial distribution.

References

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Figures

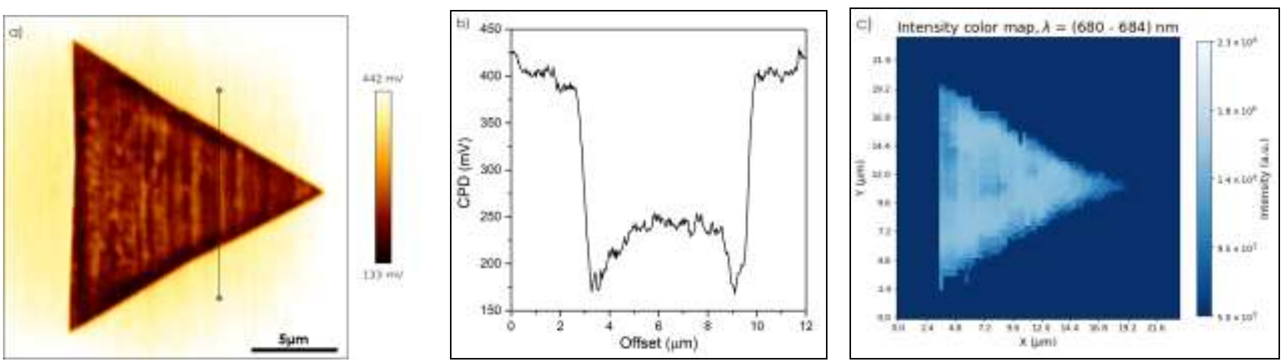

Figure 1: a) KPFM map of MoS_2 monolayer on SiO_2/Si substrate. b) Line profile of contact point difference shown in a). c) Corresponding PL optical map obtained at room temperature. Wavelength range includes A exciton PL peak.